Study of Tinea Capitis in Philadelphia Using Case and Control Groups

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DERMATOPHYTOSIS of the scalp is well described in the medical literature in regard to its clinical manifestations and the identification of causative organisms (*1*). Surveys of population groups in the United States (*2–8*), Canada (*9–11*), and Europe and Africa (*1*) have also been reported. Such surveys contribute information on the occurrence and distribution of the infection, but provide a limited basis for conclusions regarding etiologically related factors or the modes of transmission. Clinical opinions are available, too, (*2–16*), but they are not supported by statistical epidemiologic evidence.

We undertook a study of tinea capitis in Philadelphia, using cases and controls, to explore the effects of economic status and hair care practices on the occurrence and transmission of the infection.

Materials and Methods

Between February 1, 1965, and April 30, 1966, we investigated 821 children with tinea capitis, tinea corporis, or both, who had been seen in the outpatient departments of the dermatology clinics of two pediatric hospitals in Philadelphia—St. Christopher's Hospital for Children and Children's Hospital of Philadelphia. For a comparable control population, 606 children were selected from the acute-care clinics of medical clinics of the two hospitals.

These children in the case and control groups identified the families for comparative studies. Investigation relative to clinical diagnosis of tinea capitis and tinea corporis included examination of most persons under Wood's light.

Homes of the patients in the case and the control groups were visited by Miss Reid. A pretested questionnaire regarding financial status, home conditions, and hair care was filled out from information provided by the mother or the senior female in charge of the family unit.

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Hair and skin specimens for microscopic examination and culture were taken from all children with index cases and their families and from all controls and their families. The specimens were inoculated on Sabouraud glucose agar with chloromycetin and cycloheximide and Littman's oxgall agar (*5*). Of the cultures made from specimens from the persons under study, 37, or 2 percent, became contaminated and were discarded.

The results on the remaining cultures were tabulated, and various factors suspected to be associated with tinea capitis were analyzed. Statistical significance is indicated when the possibility that the difference occurred by chance was below the 5 percent level.

Results

We carried out our investigation in areas of Philadelphia having predominantly Negro residents. Both the case and the control groups reflected the population from which they were drawn; 384 of the 394 total families were Negro. Following are the number of families and persons in the study by sex and age groups:

Categories	*Case group*	*Control group*
Families	209	185
Persons	1,020	762
Boys 0–16 years	486	305
Girls 0–16 years	335	301
Men	41	15
Women	158	141

Family characteristics. The families in the study had from one to nine children. The mean number in the case group was 3.9±1.5 and in the control group, 3.3±1.3. This difference is not statistically significant, but the proportion of large families (more than four children) was significantly greater among the case group (51.7 percent) than among the control group (41.1 percent). The ratio of male to female children was also higher among the case group (59 percent) than among the control group (50 percent). The proportion of children under the age of 5 years was higher in the control group (39 percent) than in the case group (32 percent).

Family income, as reported by the mother or senior female of the family, was available on 168 case families and 157 control families. The mean income of the case families was $3,500±$170 and of the control families, $3,200±$190. More than 60 percent of the case and control families reported annual incomes of less than $3,000. Thus, both groups were drawn from a poverty population, but within this population there was no association between economic status and tinea capitis. If anything, the mean income of the control group was slightly lower than that of the case group.

The length of residence in Philadelphia was ascertained. In the case group, 13 of 209 families, or 6 percent, had lived in Philadelphia for less than 4 years, and in the control group this proportion was 9 of 185 families, or 5 percent. Approximately 85 percent of both groups had been residents for more than a decade. Thus, there is no indication that recent migration into the area was associated with the occurrence of tinea capitis in the family.

Characteristics of the infections. Of the 472 cultures obtained for our study, *Microsporum audouinii* accounted for 83 percent of the infections. The second most frequent infection was caused by *Trichophyton sulfureum* and *Trichophyton tonsurans*, which some workers regard as a single species. Following is a summary of the data on the 472 cultures:

Species	*Case group*	*Control group*
Total isolates	466	6
Microsporum	387	5
M. audouinii	384	5
M. gypseum	2	0
M. canis	1	0
Trichophyton	79	1
T. sulfureum	54	1
T. tonsurans	25	0

When 343 children with *M. audouinii* infections were examined under Wood's light, 288 showed fluorescence and 55 did not. The lack of fluorescence was significantly higher among girls—36 percent of 78 girls in contrast to 10 percent of 265 boys.

The infection was localized to the scalp in 93 percent of the 466 children with positive cases for whom information was available on the anatomical distribution of the lesions. In 32 patients, the infection was limited to the body and did not affect the scalp; in only one patient were

both the scalp and the body affected. *Trichophyton* infections were seen more frequently on the body than *Microsporum* infections—10 of 79 cases, or 12.7 percent, for *Trichophyton*, as compared with 22 of 387 cases, or 5.7 percent, for *Microsporum*. The difference, however, is not statistically significant.

Characteristics of infected persons. By definition, all families of children in the case group had one or more persons who were infected. In the control group, six of 606 children had positive cultures. The inclusion or exclusion of these sporadic cases does not influence the conclusions reached in the study.

The rate of infection was lower among the adults of the case group than among the children. Among 41 men in the case group, five (12 percent) were positive for *M. audouinii*. Among 158 women, there were 19 positive cultures for *M. audouinii* and one for *T. sulfureum*, an infection rate of 13 percent. No dermatophytes were isolated from the 156 adults of the control group.

Table 1 presents data on the occurrence of infections among the siblings and other children of families in the case group, excluding the probands. The results show that microsporosis spreads more extensively in families than does

Table 1. Infections in children of case families, except probands

Infection type by age group (years)	Boys			Girls		
	Number	Infected		Number	Infected	
		Number	Percent		Number	Percent
Microsporosis (163 families):						
Total	236	124	53	247	76	31
0–4	103	51	50	79	30	38
5–8	72	41	57	82	35	43
9–16	61	32	53	86	11	13
Trichophytosis (44 families):						
Total	73	21	29	56	12	22
0–4	13	3	23	14	4	29
5–8	29	13	45	18	7	39
9–16	31	5	16	24	1	4

Table 2. Hair care habits of case and control groups

Habits by sex	Case group		Control group	
	Number	Percent	Number	Percent
Boys	477	100.0	301	100.0
Use barbershops	364	76.4	223	74.1
Use haircream	358	75.0	243	80.8
Share combs	316	66.2	176	[1] 58.5
Share hairbrushes	337	70.7	197	65.6
Share caps	198	41.5	76	[2] 25.2
Share beds	244	51.2	138	45.8
Wash hair more often than weekly in winter	94	19.7	92	[2] 30.6
Wash hair more often than weekly in summer	42	8.8	34	11.3
Girls	333	100.0	299	100.0
Use haircream	321	96.4	280	93.6
Share combs	256	76.9	213	71.2
Share hairbrushes	227	68.1	222	74.2
Share beds	190	57.1	151	50.5
Wash hair more often than every 2 weeks	71	21.3	55	18.4

[1] Significant difference ($P = 0.02$).
[2] Significant difference ($P = 0.01$).

trichophytosis. This characteristic is evident for both sexes. Both types of infection occurred more often in boys than in girls—in 47 percent of the boys and 29 percent of the girls. Whether this variation is to be attributed to a greater susceptibility of males than of females or to some environmental difference, such as shorter hair, is not clear. A drop occurs, however, in the infection rate for girls older than 9 years, whereas the rates for boys of the three age periods are not significantly different.

An analysis was made of the rates of infection by the number of children in the family units. No consistent or significant trends were elicited among the 163 families with more than one child infected with *Microsporum* or among the 44 families with more than one child infected with the *Trichophyton* species.

Hair care. Table 2 summarizes some characteristics associated with hair care among the 810 children in the case group and the 600 in the control group. A comparison of children in these two groups by sex revealed three characteristics in which the boys differed significantly from the girls, namely, in the sharing of combs and caps and in less frequent shampoos during winter.

The hair care habits of families in the case group who had *Microsporum* infections were analyzed. The families were divided into two groups. One comprised 63 families with 165 boys in which one or more brothers of the proband were also infected. The other consisted of 43 families having 107 boys in which none of the brothers was infected. A comparison of these subgroups did not accentuate the differences recorded in table 2, nor add any additional differences.

Discussion

Our study of tinea capitis establishes a firm basis for some of the usually held opinions regarding the distribution and transmission of this disease in human populations.

Ringworm of the scalp most commonly afflicts poor, overcrowded populations, as shown uniformly in surveys throughout the world (*1–12*). Our study indicates that within such populations, however, reported annual income per se is not associated with tinea capitis. Ringworm appears to be associated with a greater number of children, especially boys 5 years and older. A greater number of children would tend to accentuate overcrowding and poor hygiene.

Since both the case and control groups were drawn from a predominantly Negro population, our study yielded no information on the relative frequency of occurrence of tinea capitis in Negro and non-Negro populations. To be valid, such comparisons must take social and economic levels into consideration. The epidemic proportions of mycotic scalp infections in poor urban districts of Switzerland (*12*), among rural white populations of Quebec (*9–11*), and in the multiracial population of Senegal (*13*) certainly establish that the infections are not limited to Negroes. Specially designed studies will have to be carried out to ascertain whether any ethnic group is especially susceptible to tinea capitis.

In Philadelphia, in contrast to the patterns seen in Quebec (*9–11*), the chief dermatophyte involved in tinea capitis infections was *Microsporum audouinii; Trichophyton sulfureum* and *T. tonsurans* were one-fifth as prevalent. The spread of *M. audouinii* in families was approximately three times that of the two *Trichophyton* species. This result indicates that *M. audouinii* is a more infectious agent than the two *Trichophyton* species and confirms the clinical observations of Sabouraud (*17*) and Rivalier (*18*).

Tinea capitis is primarily an infection of children, and boys are infected more frequently than girls (*1, 17*). Among children in families of the probands, dermatophytes were isolated from the scalps of 57 percent of the boys and 29 percent of the girls. Among adults, in families of the probands, the infection rate was 13 percent in women and 12 percent in men. Several authors (*10, 19, 20*) indicate a higher prevalence of infection in women than in men.

The prevalence rates in our study, in adults as well as in children, are certainly of epidemic proportions. The high rate of infection among adults is of particular importance in public health programs aimed at controlling the disease. Since tinea capitis among adults is often clinically less severe than in children, adults are less likely to be under treatment, and they may

be unrecognized carriers in endemic areas (*1*, *19*, *21*).

Girls manifest a reduction in the prevalence rate by the time they are 9 years of age. Additional studies are necessary to determine whether the age and sex differences in the occurrence of tinea capitis are attributable to different hair styles or hair-care practices or are related to endocrine or immunological factors.

Poor hygienic practices of boys, including the sharing of combs and caps and their less frequent hairwashing than girls, have been shown to be associated with tinea capitis. The data suggest the same trends in infection for girls who share combs and beds, but the associations are well within the range of chance occurrence. We found no connection between tinea capitis and the use of barbershops.

One of the opinions regarding tinea capitis of the endothrix type is that it is brought into an area by immigrants (*22*). This point was shown not to be valid in Canada (*10*), and in the Philadelphia population, also, almost all of the families were long term residents of the city. The source of the infective agent is therefore best sought in the endemic setting and not as an importation.

The advent of griseofulvin as an effective chemotherapeutic agent against tinea capitis may have lessened interest in the epidemiology of the infection. In wide clinical use of this medication, however, we must take into consideration that griseofulvin increases the occurrence of hepatocellular carcinomas in mice (*23*). Further epidemiologic studies may clarify the mode of spread of tinea capitis and the susceptibility of the host sufficiently to permit preventive rather than curative measures.

Summary

A study of tinea capitis, using cases and controls, was carried out in Philadelphia, Pa., in 1965–66. Dermatophytes were isolated from the scalps of 472 of 1,782 persons; 83 percent were of the *Microsporum species* (*M. audouinii* in all but three instances), and 17 percent were of the *Trichophyton* species.

In families of the case group, infections were found in 47 percent of the 486 boys and in 29 percent of the 335 girls, as well as in 12 percent of the 199 adults. Among families of the control group, dermatophytes were isolated from 1 percent of the 606 children and none of the 156 adults.

Tinea capitis in families was associated with having a large number of children, especially boys 5–16 years old, and with boys sharing their combs and caps and having less frequent shampoos during winter.

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Cervical Cancer Screening Projects

Nationwide cervical screening projects, supported by the National Center for Chronic Disease Control of the Public Health Service, are responsible for saving or prolonging the lives of thousands of American women, according to an analysis of Center reports over a 5-year period, beginning in 1962.

More than 1 million cytology examinations have been made at various hospitals throughout the country. Cervical cancer was found in more than 6,500 women; more than 4,000 cases of carcinoma in situ were detected.

There are 143 grant-supported projects in 35 States, the District of Columbia, and Puerto Rico. Effort has been concentrated on the low-socioeconomic groups because of their high risk of cervical cancer.

The Center's cancer control program also supports the American Academy of General Practice in its "office detected cancer program." The Academy program, in effect since 1965, includes 4,000 physicians in 36 States and the District of Columbia. More than 546,000 women have been screened—one-third of them for the first time. According to latest available reports, 1,059 carcinomas have been detected, 865 in situ and 194 invasive.

The Academy program, organized with the assistance of the Center's staff, calls for Papanicolaou examinations. All patients with suspicious or positive results are followed up to insure that they are diagnosed and treated if cancer is present. Those treated for cancer are scheduled for periodic checks to make sure that therapy is adequate and that there is no recurrence of growth.

An estimated 26 percent of the women over 20 years of age in the United States were cytologically examined in 1966, up from 15 percent in 1963 and 10 percent in 1961. In comparison, British Columbia's rate is about 65 percent.

All screening projects supported by the National Center for Chronic Disease Control subscribe to certain standards, such as tissue diagnosis, definitive treatment, and adequate followup. In other respects, the projects are controlled and conducted by the institution receiving the grants.